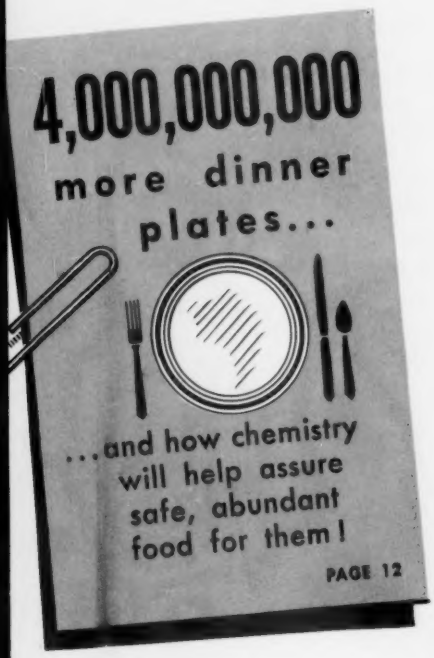
AGRICULTURAL NEWS LETTER

VOL. 29 No. 2 SUMMER 1961



This publication contains information regarding new developments of interest to agriculture based on laboratory and field investigations by the Du Pont Company. It also contains published reports of investigators at agricultural experiment stations and other institutions as related to the Company's products and other subjects of agricultural interest.

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AGRICULTURAL NEWS LETTER

Published Three Times Annually
by the Public Relations Department
E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Wilmington 98, Delaware

THE AGRICULTURAL NEWS LETTER serves as a medium of reporting new developments and ideas in agriculture, particularly those related to advancements through research. Material herein may be reprinted, in whole or in part, in the interest of advancing the general knowledge of new agricultural practices.

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First Things First

It is perhaps more than a coincidence that Premier Khrushchev and two of his allies found much to complain about in the state of their agriculture in recent months. The Soviets have exiled to Siberia their minister of agriculture for the poor performance of Russian farms. Mao Tse-tung admitted that Red China's agriculture was facing disaster. And, finally, Fidel Castro is trying to restore Cuban agriculture by a heavy dose of collectivism and a plan to train all youth over 10 in farming.

On the basis of past performance with collectivized agriculture, it is no act of clairvoyance to predict that their problems will not soon vanish. Agricultural collectivism has so far been the major failure of every single Communist state.

If the inefficiency inherent in Soviet-style agriculture were nothing more than that, it would hardly ruffle the feelings of the Communist world. It would be dismissed as a minor irritant incumbent upon those who seek "progress." But that inefficiency is a major limiting factor in all Communist growth schemes and must be taken into calculation in every economic plan put forth. A significant contributor to the failure of each economic five-year plan was failure of agriculture.

For, in Soviet Russia, which boasts loudly of its ability to eventually conquer U. S. economic advances, it takes about 40 per cent of the labor force to run the collectivized farming community. It takes 10 per cent in this land of "capitalistic reaction." Such a disproportionate absorption of the labor force in agriculture — on top of the inability to deliver the goods — has deprived the Communist countries of the rising labor force needed to expand other areas of production and especially those providing some addition to consumer goods. This is, in fact, the basic explanation for Soviet Russia's inability to raise its total output of goods and services beyond about 45 per cent of U. S. output.

In the United States, the free economy has been an incentive to efficient agricultural production, which, in turn, has released a major share of the labor force for other functions. There would be no such mighty industrial plant and unprecedented service organization, were it not for the ability of agriculture to produce food and fiber — the *sine qua non* of any economy — with a relatively small expenditure of human effort. Again, driven by the incentive of a free-enterprise system, that human effort has found its way into other channels of economic activity. In its wake, it has created the highest living standard for those who live in that system, as well as providing the economic independence of the individual essential to maintenance of his political freedom.

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NITROGEN FIXATION BY ENZYME PREPARATION

Du Pont scientists, who last year solved a part of the mystery surrounding nitrogen fixation by living cells,* have now gone a further step by separating two essential components of the fixation process. The atmosphere is the ultimate source of nitrogen for all forms of life. But, since atmospheric nitrogen is relatively inert, it can be metabolized by only a few living organisms that are endowed with remarkable catalytic power. Man has been able to duplicate this feat of nitrogen fixation only under conditions of extreme pressure and temperature.

Duplication of the enzyme process outside the living cell could be of great significance to agriculture and chemistry. But the mechanism still remains a mystery. The major problem — the one which was solved last year — has been the lack of a technique for extracting the enzyme. Once this was accomplished, further studies were undertaken to determine the nature of the enzyme — with the hope that the system could be eventually unraveled and one of the major life processes understood.

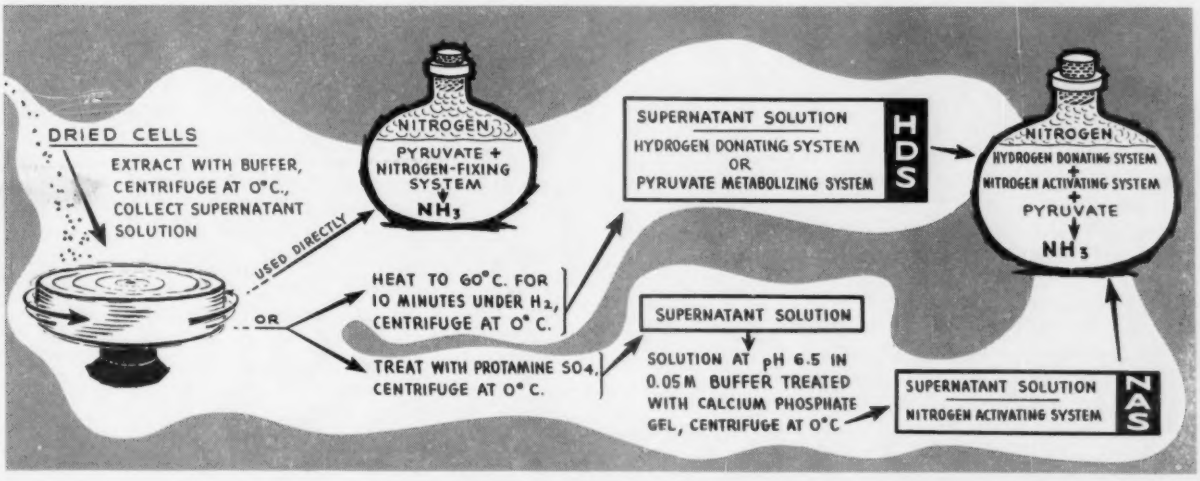
The nitrogen-fixing extract was obtained from *Clostridium pasteurianum*. Subsequent studies have resulted in the isolation of two fractions which do not fix nitrogen unless combined. The significance of the process is still not fully understood. Indications are, however, that one fraction contains the long-postulated enzyme nitrogenase (NAS) and the other the hydrogen-donating system (HDS). The fractionating process is shown in the accompanying illustration.

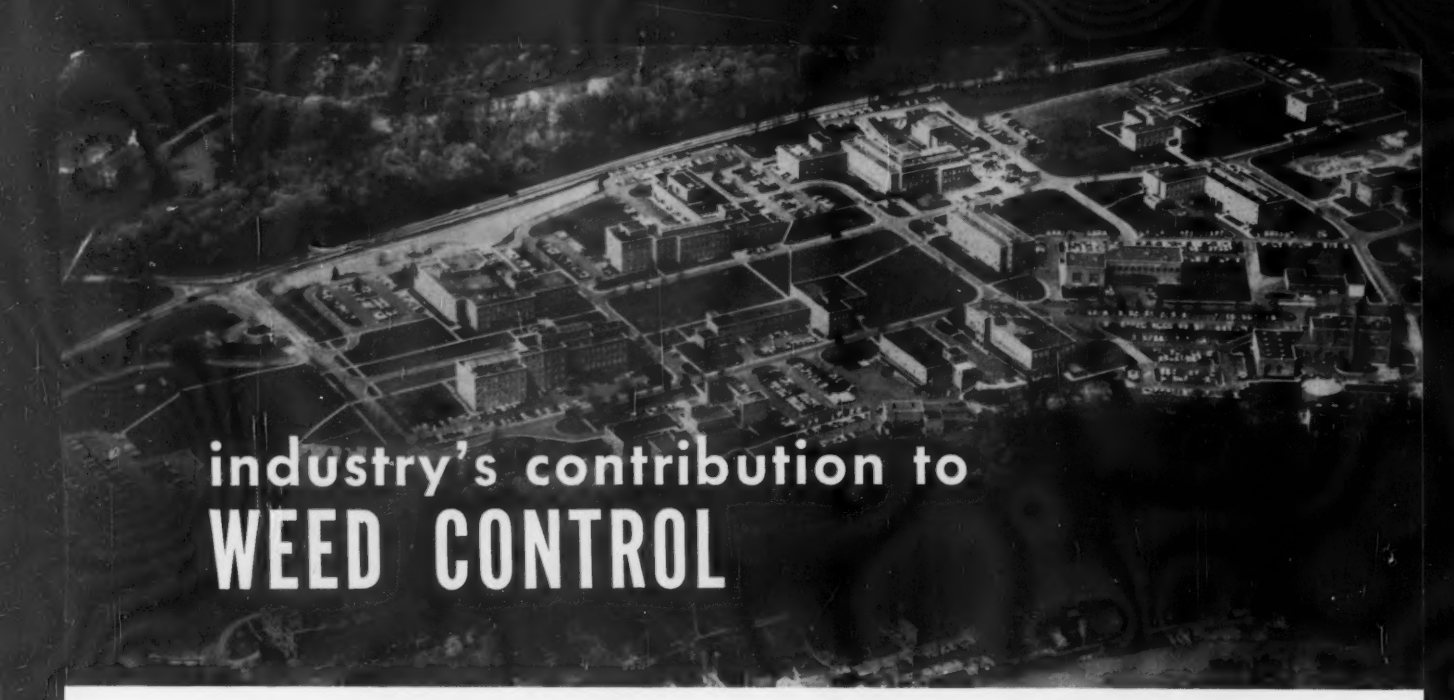
Assignment to these fractions of their role in nitrogen absorption and hydrogen donation was originally made on the basis of the spectral response to nitrogen found in NAS and on the phosphoroclastic and hydrogenase activities in the HDS. This hypothesis has been supported by further experiments.

It was found that extracts from *C. pasteurianum* grown on ammonia did not have the ability to fix nitrogen, and this defect was traced to the fact that the NAS component was inactive. It had previously been found that organisms do not fix nitrogen when ammonia is available. Further experiments were made to study the effects of carbon monoxide on the enzyme fractions. CO inhibits nitrogen fixation, reacting with at least three components in the extracts. One of these components is in the NAS and two, including hydrogenase, are in the HDS. Data on fixation with fractions in which the two CO-sensitive fixation components were inhibited one at a time support the conclusion that the NAS contains nitrogenase and HDS the enzymes and coenzymes for producing electrons.

*"Du Pont Scientists Find Secret of Nitrogen Fixation," *Agricultural News Letter*, 28:2, Summer, 1960.

ANOTHER STEP has been taken in unraveling the mystery of nitrogen fixation by living cells: Du Pont scientists who last year performed the process in vitro have now isolated two fractions of the fixing enzyme by the process shown in the diagram.


DRIED CELLS
EXTRACT WITH BUFFER, CENTRIFUGE AT 0°C., COLLECT SUPERNATANT SOLUTION
USED DIRECTLY
OR
NITROGEN
PYRUVATE + NITROGEN-FIXING SYSTEM
NH3
HEAT TO 60°C. FOR 10 MINUTES UNDER H2, CENTRIFUGE AT 0° C.
TREAT WITH PROTAMINE SO4, CENTRIFUGE AT 0° C.
SUPERNATANT SOLUTION
HYDROGEN DONATING SYSTEM OR PYRUVATE METABOLIZING SYSTEM
HDS
SUPERNATANT SOLUTION
SOLUTION AT pH 6.5 IN 0.05 M BUFFER TREATED WITH CALCIUM PHOSPHATE GEL, CENTRIFUGE AT 0°C
SUPERNATANT SOLUTION
NITROGEN ACTIVATING SYSTEM
NAS
NITROGEN
HYDROGEN DONATING SYSTEM + NITROGEN ACTIVATING SYSTEM + PYRUVATE
NH3



industry's contribution to WEED CONTROL

By DALE E. WOLF*
Industrial and Biochemicals Department
E. I. du Pont de Nemours & Co. (Inc.)

Teamwork is the key to the spectacular progress of chemical weed control in recent years. Basic chemical knowledge has advanced in universities, government, and industry. Farmers have seized the opportunities which these discoveries have given them. A healthy and growing chemical industry has been able and willing to devote large expenditures to research and substantial investments, even when chemical weed control was a long way from success.

Industry, particularly the chemical industry, is recognizing more and more that its future is built on fundamental research. Du Pont has 2,300 technically trained people engaged in research and development, at an annual cost of about $90 million. About one-sixth of the money and manpower is spent on fundamental research in organic, inorganic, and physical chemistry, physics, microbiology, biochemistry, and engineering.

Not many years ago, it would have been inconceivable that a commercial company would go deeply into fundamental research in the specialized field of plant growth. But, the chemistry of life processes in living cells represents one of the most promising fields of study for future biochemical discoveries. The behavior of chemicals in living systems depends on intricate reactions in the enzymes and nucleic acids of individual cells. Reactions are sensitive to slight influences, and they occur in successions and combinations which are presently difficult or impossible to duplicate.

A better understanding of life processes will bring us closer to prescribing molecular formulas to fit given biochemical needs. Understanding biochemical activities in living cells would also help to overcome some of the major problems in establishing safe levels of exposure to chemicals. It may simplify or even eliminate the cumbersome bio-assays with laboratory animals.

New Analytical Techniques

A second important field of exploration is in testing and analytical techniques. These are concerned not only with plant responses, residues, and toxicology, but with all fundamental biochemical research. We have to identify and measure various synthetic and natural compounds in controlled or uncontrolled biochemical reactions to know the chemical situation we work in. We must differentiate infinitely small amounts of compounds from closely related or similar chemicals.

We also need to progress in reducing the cost and time required to establish safety of chemicals to be used in food. The time between the discovery of a biochemical compound and the start of commercialization is from four to seven years. The cost of establishing safety is on the order of half a million dollars and involves testing over

* *Excerpts from an address before the Southern Weed Conference, Saint Petersburg, Fla., January 18-20, 1961.*

Du Pont has a 160-year tradition of research. Founder Eleuthère I. du Pont de Nemours brought with him to America knowledge and philosophy acquired in the laboratory of the great Lavoisier. In 1902, long before research became a way of life for industry, Du Pont built the Experimental Station whose sprawling "campus" illustrated above is a growing Du Pont landmark. More on Du Pont research may be found in the "Agricultural News Letter" of Fall, 1960, and "The Story of Technology," both of which may be obtained from Editor, Agricultural News Letter, Du Pont Co., Wilmington 98, Del.

several years. These costs must inevitably appear in the price of the product. If any product fails, then another must bear the cost.

Future discoveries in weed control depend on overcoming some of these fundamental problems. Progress will depend on continued dedication to basic research by government and university scientists. But, it will also depend upon the willingness of industry to support the required research and then to take the capital risks involved in manufacturing and marketing products research has uncovered.

Industry is one means of consolidating many fields of science and engineering, and directing capital resources and human talents to projects a single scientist would never think of tackling. The result is that discoveries need not languish in test tubes or stop at the laboratory level if they give promise of meeting a human need.

Using Industry Resources

It seems only right that the cost of developing a product should primarily be borne by industry. Before sending a product out for evaluation by federal and state laboratories, an industrial concern must decide that it intrinsically has enough merit, is safe enough, and is of sufficient economic value so the company is willing to say that the product is likely to be marketed.

This decision must be reached on the basis of adequate information developed through its own resources — even though future evidence may force an end to commercialization. Information leading to the initial decision should be developed through the company's own resources. State and federal laboratories cannot be free testing agencies for hundreds of purely experimental, untried products and formulations. The industrial weed control development team has to determine the true value of its candidates before offering them to federal and state laboratories.

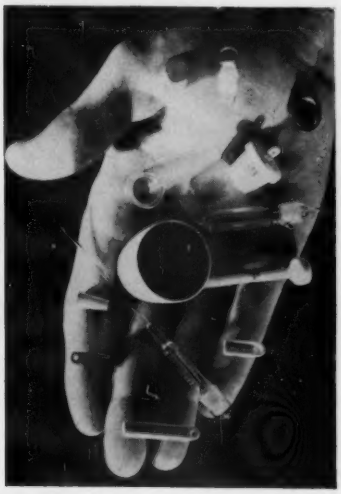
Once the basic facts about a new weed control chemical have been established, and the material promises to have one or more economically important uses, then it seems essential for it to be discussed with federal and state authorities and made available for such evaluation appropriate to their interests and responsibilities.

Knowledge of Plant Growth

The record of chemical weed control in agriculture and in industry speaks for itself. Farmers are using chemical practices which did not seem possible when the science of weed control was in its infancy. Cotton has progressed from a high-labor to a low-labor crop as chemical weed control has been added to other technology. Weed killers are used commercially where it once seemed impossible — as in spinach, and in selective weeding of grasses in the Pacific Northwest. Farmers are making spot treatments for noxious weeds in various crops, even though the crop may be susceptible. Chemicals are keeping irrigation and drainage ditches free of unwanted vegetation without damage to cropland. Equipment, methods of application, and timing have been adapted in ways that seem almost incredible.

Furthermore, our success with weed control is broadening our practical knowledge of the whole field of plant growth regulation — so that laboratory screening programs evaluate all responses of plants to candidate chemicals, rather than just the killing effect. The science of weed control has much to gain from the incentive and initiative in our American economy which permit commercial companies to commit substantial resources in money, manpower, and equipment to this important field. It is a challenge and a responsibility we accept gladly.

"We must differentiate infinitely small amounts of compounds from closely related or similar chemicals . . ."



"Industry is one means of consolidating many fields of science and engineering, and directing capital resources and human talents to projects a single scientist would never think of tackling. The result is that discoveries need not languish in test tubes or stop at the laboratory . . ."

'60 census confirms it

AS TIMES CHANGE SO DO JOBS

It had been evident for a decade, but the 1960 Census gave official confirmation: The United States has experienced its second "job revolution" in less than 50 years.

The first revolution, a little more than 40 years ago, saw the industrial worker replace the farmer as the most numerous U. S. workingman. Now, in a second dramatic shift, the so-called "service worker" (in trade, finance, communications, utilities, government, etc.) has become predominant. These men and women now compose the majority of the entire work force, outnumbering farmers, manufacturing workers, construction men, and miners combined. If the trend continues, they will outnumber production employees by 35 per cent in 1970.

Revolution Number One

The reasons for these revolutions are easily discerned. In 1860, when America was a nation of farmers, a good farm hand with a walking plow and harrow could raise an acre of corn through 30 hours of hard work — and by the standards of the day, it was a marvelous performance. Steel plows, threshing and mowing machines, reapers and straddle-row cultivators were then new inventions, and they had changed the face of U. S. agriculture. The farmer of 1860 doubtless regarded them as the marvels of the world, and thought it hardly possible that they could be improved upon.

Yet, they were improved upon. By 1920, the farmer had a gang plow and four-section harrow, a two-row planter and a two-row picker. He could produce an acre of corn in eight hours' working time. His over-all efficiency had more than tripled; his job was easier and his financial rewards far greater than his grandfather's had been.

But in terms of numbers, the farmer was no longer the "average American." As farming efficiency rose, the nation's need for farmers declined proportionately. There were more farmers in 1920 than there had been in 1860, but as a percentage of the total work force they had slipped to second place (*see the accompanying graph*). The industrial worker had become the largest element in the business geography of America. Job revolution Number One was complete.

Revolution Number Two

The factory worker of 1920 also regarded his machines as the ultimate marvels of the world. Auto workers, aided by motor-driven conveyors, could assemble a Ford chassis in a little over an hour and a half, and were earning $5 a day. Using 162 complex machines, Ford could produce 108 cylinder heads an hour. All these things were marvelous — and in many minds, seemed beyond improvement.

Yet they were improved upon. By 1960, the 1920 assembly line and the $5 wage seemed absurdly antique, and the 162 complex machines had been replaced and outproduced by a single fully automatic broach. Meanwhile, the farmer had redoubled his efficiency. With a half-pound of a single weed-killer — 2,4-D amine — he could save four man-hours of hand weeding in the field. With the latest motorized equipment he could produce an acre of corn in perhaps two hours' working time, or less.

When Census time came in 1960, the farmer and the industrial worker were more productive than ever before, and personal incomes were at an all-time high. But there were far fewer farmers than there had been in 1920. And although industrial employment had climbed, the manufacturing employee was no longer the "average" U. S. working man. The person in the service job had taken that title. Job revolution Number Two was complete.

Technology Is the Mainspring

Thus a single century saw a total change in the U. S. employment pattern, and the change came about at an accelerating rate. The force behind this change is obvious. It is mechanization, which

SWEEPING CHANGE in U.S. job patterns, 1860-1960, has been marked by a vast expansion of service industry payrolls, steep decline in farm jobs, and gradual increase in share of manufacturing.

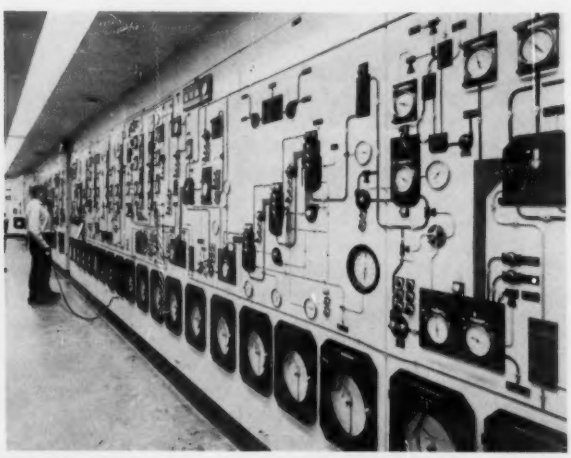
FARM jobs formed backbone of U.S. economy in 1860, when six workers in every 10 were farmers. Factories employed one man in five.

FACTORY and construction jobs numbered more than 12 million in 1920, surpassing farm total by approximately one million.

SERVICE industries became dominant employment factor in 1950s. Farm jobs shrank to one in 10. Manufacturing share grew slightly.

first freed the farmer for other work, then created a vast and increasingly prosperous network of industry, and, most recently, enabled the nation to afford (in time and money) an equally vast network of services, which often represent refinements in man's way of life.

These changes will undoubtedly continue. The employment patterns of the 1990's will bear little resemblance to those of today. And, if the lessons of the past can be trusted, future changes will prove desirable in the long run. Meanwhile, there will be problems as well as advantages. There will be dislocations and readjustments, mostly short-term but sometimes quite severe. Some kinds of work will disappear, as the blacksmith and ice man and whaler have all but disappeared. But new jobs will spring up in a long spiral of national growth.



MOVING FORCE behind changing employment patterns is technological progress. By increasing individual output, it has boosted living standards and sparked a tremendous growth in the over-all job total.

Like all change, these dislocations will take some getting used to. But, significantly, that will be nothing new. Not only has the nation experienced this sort of thing before — and profited greatly by it — but the American people have long been noted for their voluntary restlessness. Voluntary job shifting, for example, involves about 20 per cent of the work force each year.

Change rarely takes place without opposition and, undoubtedly, future changes in job patterns will lead to some conflicts. Yet man, in all his long history, has learned certain lessons well. First, he has learned that he cannot thwart progress; he only cheats himself. Second, he has seen in looking back that the greatest short-term dislocations, and the greatest resistance to the changes that caused them, have often been felt in areas where changes brought the greatest eventual benefit. Perhaps, that is why the opposition, however intense, has always proved so futile.

Toward National Growth

The two job revolutions of the past half-century have been part of a larger growth pattern, with the rise of service employment reflecting the social and financial rewards of technological improvements in farming and industry. The demand for these services — which now take 40 cents of every dollar spent by U. S. consumers — stems from the extra time and money which a prosperous nation can spend on recreation, health, home improvements, education, travel. Future growth will depend on further application of industrial technology. It is the mainspring of U. S. economic growth — to be welcomed, not resisted.

DU PONT DEVELOPS VERSATILE BASIC CHEMICAL

"Baymal" colloidal alumina is a versatile new industrial chemical. Du Pont research chemists say it has more unique properties and use possibilities than any chemical to emerge from their laboratories in many years. For example, one form is hard enough to machine steel or cut glass, another improves the smoothness of a skin lotion. "Baymal", a white, free-flowing powder, consists of clusters of minute fibrils of boehmite (AlOOH) alumina. A dilute water solution has unusual viscosity characteristics. A dispersion, for instance, can be changed from a very fluid solution to a very viscous sol or paste by a slight change in acidity. This is liquified by shaking or agitation. The liquid again becomes a solid on standing. The transformation can be reproduced any number of times, and the time required varied from less than a second to more than a day.

UREA UTILIZATION IN DAIRY COWS

Highest efficiency of urea nitrogen utilization and milk production can be obtained when urea is fed to milk cows in a grain concentrate mixture containing liberal amounts of corn, oats, or molasses, rather than added to corn silage. Energy available in corn silage alone was not sufficient to support non-protein nitrogen (urea and ammonia) utilization in dairy cows. Supplementation of the urea-silage combination with a readily available carbohydrate, such as corn meal or molasses, would have improved nitrogen utilization. — OHIO AGRICULTURAL EXPERIMENT STATION.

BLACK PLASTIC MULCH FOR MELONS

Black plastic mulch increased both early yields and total yields of muskmelons. Polyethylene, 2 mils thick and 3 feet wide, was placed over the row after transplanting and holes cut for the plants. Hales Best was at least a week earlier than Harvest Queen. Although results from Hales Best are more striking, both varieties showed important differences in number harvested and weight. Use of plastics has a place in crop production. Important among its uses is to make early crops earlier. Plastic mulches may be used on many different crops, including perennials such as strawberries. Seeds of most vegetables may be planted directly through holes punched in the plastic. — COLLEGE OF AGRICULTURE, UNIVERSITY OF IDAHO.

USDA RESEARCH ADVANCES IN 1960

Of major importance among 1960 farm research findings in USDA pioneering laboratories is information on how nutrients move from the soil to the interior of plants and how plants gain resistance or susceptibility to disease.

Another important gain is in the fight against insect pests. An insect attractant that occurs naturally in the female gypsy-moth was synthesized. It will aid in detecting infestations and may play an important part in future gypsy-moth control programs. Insect control may also result from chemical sterilization tried for the self-annihilation of house flies and fruit flies.

Biological control of nematodes may be possible from a newly discovered species of fungus common to Louisiana sugarcane soil and believed to be widely distributed in nature. The fungus, a type of water mold, apparently not harmful to plants, kills by penetrating the skin and growing in the bodies of nematodes.

Subsurface application could be a new technique for using volatile herbicides, increasing their effectiveness. The herbicide was applied in a thin band under the surface of cotton seedbeds before planting, resulting in 90 per cent control of weeds, compared with 75 per cent when sprayed on the surface.

In Florida, six varieties of citrus root-stock were found resistant to burrowing nematodes. Other such plants include a cabbage resistant to clubroot, two new durum wheat varieties with better resistance to Race 15B stemrust, and three new hard red winter wheats, resistant to several insects and diseases.—USDA.

ZINEB PREVENTS COTTON RUST

Cotton rust which is becoming more severe in the Southwest has been successfully controlled by zineb fungicide.* In 1960, tests and field studies conducted in Arizona and New Mexico indicated rust can be controlled when zineb is applied at two pounds per acre in 20 to 40 gallons of water. Spraying should be done at two to three week intervals, beginning at the first bloom stage of growth, or earlier, if general rains are forecast. Rust, which overwinters on grama grass, resulted in yield losses of from 25 to 75 per cent in 1959-1960. Crop damage was from premature shedding of squares and bolls. Rust cannot be eradicated once it has established itself. Successful control in these experiments depended, therefore, on having zineb fungicide on the cotton plant before the rust spores came in contact with it.—USDA.

**Du Pont manufactures "Parzate" C zineb fungicide.*

NITROGEN FERTILIZER FOR CRANBERRIES

A number of workers have published more or less conflicting reports on nitrogen fertilizers for the cranberry. A study was undertaken to compare ureaform, a slowly available form of synthetic organic nitrogen, with ammonium sulfate, calcium nitrate, and urea as a source of nitrogen under controlled greenhouse conditions. The value of ureaform under field conditions also was studied. In bog-soil cultures, it produced significantly greater runner growth and dry weights of plant parts than ammonium sulfate or urea. Plants produced significantly greater fresh weights than the other materials and significantly more runners than the controls. Ammonium sulfate produced poorest growth. Analysis of variance showed growth was significantly greater for ureaform in the later part of the experiment. A field experiment showed no significant differences in yield when the nitrogen was applied on an acre basis as (1) 300 lbs. 8-8-8 (standard) split in June and August, (2) 240 lbs. 10-10-10 (N as ureaform) in June, or (3) double treatment No. 2. Storage studies showed no significant differences in softness or decay due to treatment.—RUTGERS UNIVERSITY.

COVERS FOR TRENCH SILOS

Six different seals or covers for trench silos were checked during three years to compare their effectiveness in preventing top spoilage of silage. Plastic films made excellent covers when weighted with dirt or sawdust. Losses were completely eliminated with dirt over the plastic and almost eliminated with sawdust. Felt building or roofing paper, covered with dirt or sawdust, is inexpensive, but losses through top spoilage are considerably greater. In all cases, there was complete breakdown of the felt material between the silage and the dirt or sawdust. This did not occur with plastic, and, consequently, there was no layer of wet and rotted silage immediately under the cover. — AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF GEORGIA.

HOOD IMPROVES AIR CIRCULATION IN GREENHOUSE

Good air circulation is important in greenhouses. Without it, plants near ground level are cold and damp while heat is wasted at the top. Simply constructed hoods under the heaters induced circulation and corrected undesirable temperature and humidity conditions. As air in the heaters became warm and was forced out, cool air near the ground was pulled up the hoods. This, in turn, was heated, forced out into the house, cooled, settled to the ground, and returned to the hood. This cycle tended to make for much less stratification in the house. Such circulation could have been achieved by fans only at considerable cost, with recurring upkeep needed. — AGRICULTURAL EXPERIMENT STATION, MISSISSIPPI STATE UNIVERSITY.

LEAF ANALYSIS IS GUIDE TO ORANGE FERTILIZATION

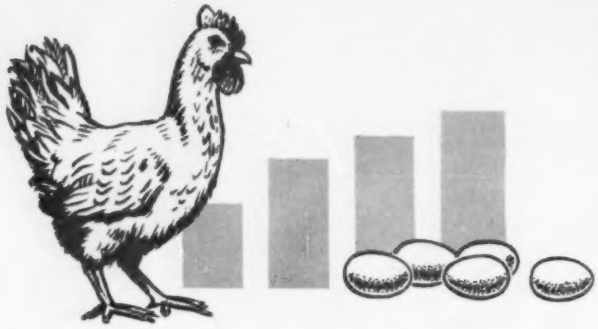
Studies have suggested that a nitrogen control program for oranges should be based on leaf analysis rather than on pounds of nitrogen per tree. Samples, taken from healthy trees only, should be spring-flush leaves from non-fruiting and non-flushing terminals, four to six months of age. The orchard should be judged for uniformity, and areas that appear to be different in tree size, condition, foliage color, foliage density, fruiting, etc., should be sampled separately. When the per cent nitrogen in the leaf on a dry weight basis is deficient, applications should be increased, perhaps to double the former rate. When nitrogen is too high, the next scheduled application should be decreased or omitted, and further applications withheld until the leaf nitrogen values fall to the adequate range. — CALIFORNIA AGRICULTURAL EXPERIMENT STATION.

FERTILIZATION OF PECAN TREES

Old non-bearing Stuart pecan trees in Georgia, which had been sparsely fertilized during their productive life, jumped into a crop of 66 pounds per tree after fertilization. The crop grossed nine times the cost of fertilizer. Such response to fertilization cannot be expected from pecan trees which are diseased, or are not protected against disease and insects. But, the one-year test is promising evidence that healthy, protected trees do not have to be relegated to "shade only." The basic fertilizer program consisted of 100 pounds of 4-12-12 per tree, plus an extra 3.35 pounds of nitrogen from 10 pounds of ammonium nitrate. Trees receiving six pounds of zinc sulfate (for control of Rosette disease) did consistently better.—SOUTHEAST GEORGIA BRANCH EXPERIMENT STATION, MIDVILLE, GA.

ENZYME ACTIVITY AFFECTS PLANT RESISTANCE

A difference in enzyme activity makes some plant varieties resistant to certain fungus diseases. Verticillium and fusarium wilt fungi of tomatoes produce an abundance of pectin-splitting enzymes to which some plants are more susceptible than others. Tissues of susceptible varieties contain much greater enzyme activity after infection than resistant tomatoes. This is a major step forward in fundamental plant disease research, since scientists did not know why some plants were resistant and others susceptible. The ultimate reason for differences in enzyme activity still is not known; differences in oxidizing enzymes and other oxidizing substances may be responsible. Research with verticillium wilt in potatoes and black rot in sweet potatoes also suggests that pectin-splitting enzymes are responsible for some of the disease symptoms. — COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN.



METHIONINE

Profitable methionine supplementation of laying rations is rapidly emerging from the realm of nutritional theory and experimental results into a promising commercial practice. Methionine is normally the first limiting amino acid in commercial laying rations, especially high energy formulae, just as it is in broiler and turkey diets. Thus, it is a critical factor in raising the ratio of egg production to feed consumption, which is the egg producer's chief hope of maintaining or increasing his profit.

The advantages of methionine supplementation are evident from the results of tests made recently by the University of Delaware and the Babcock Poultry Farm of Ithaca, N. Y. Methionine hydroxy analogue added to the diet improved over-all laying hen performance in each of four camparisons, the increase ranging from nine to 22 per cent. Specifically, feed conversion improved an average of 11 per cent. Additionally, in the University of Delaware experiment,[1] considerably better feathering was observed on birds receiving added methionine, presumably because it corrected the tendency toward feather-picking and even cannibalism in methionine-deficient flocks.

Increased Profit

The money value of methionine supplementation is evident from one of the Babcock tests under commercial conditions. A five-month trial brought from 11 to 20 cents more profit per bird when 2.0 to 2.5 pounds of "Hydan" methionine hydroxy analogue feed supplement was added per ton of laying mash. Hens on one of the supplemented diets averaged one dozen eggs on 3.5 pounds of feed over the test period.

The theories that led to these successful results were based on studies conducted over the past 20 years, involving factors that have been shown to effect the eating habits of laying hens. These studies include T. C. Byerly's formula for predicting feed consumption for a given period by layers of known body weight, with known egg producing capacities on nutritionally adequate diets.[2] F. W. Hill of Cornell University added a method of adjusting these predictions on the basis of season of the year and energy content of the diet.[3]

"Nutritionally adequate" has become the key term as the various factors in these formulae have been adjusted to improve feed conversion in laying flocks. To achieve the greatest feed conversion efficiency, the feed actually consumed must provide the amount of each nutrient required for body maintenance and egg production. The daily intake of digestible methionine, for example, must supply the sum of the amount needed for egg composition and body maintenance. If such an essential nutrient is deficient in the normal rate of feed intake, then the hen is able to overeat to make up the deficiency. Although overconsumption may maintain egg production, even at a high rate, it results in a loss of feed efficiency. The required concentration of methionine in the diet depends, therefore, upon the optimum rate of diet intake which, in turn, is influenced by body size, production rate, season, and energy content of the diet.

Methionine Requirements

Some of the variations in the estimated methionine requirements of a four-pound laying hen are shown in the following table:

TABLE 1. Influence of Season and Level of Production on the Estimated Methionine Requirements of a Four-Pound Hen on a Diet Containing 975 Calories of Productive Energy per Pound.

Production %	Cold Weather Methionine Required % of Diet	Lbs. Feed Per Dozen Eggs	Hot Weather Methionine Required % of Diet	Lbs. Feed Per Dozen Eggs
70	.289	4.44	.333	3.86
80	.299	4.10	.345	3.57
90	.310	3.84	.356	3.34

Similar figures for other bird weights and diet energy levels have been calculated by Du Pont nutritionists on the basis of these feed consumption formulae. The values closely parallel those derived by Dr. G. F. Combs,[4] of the University of Maryland.

In general, methionine requirements increase with factors which lower total feed consumption, such as high energy content or warm weather, as well as with factors which normally increase total protein requirements, such as high rate of egg production per unit of body weight.

Dr. M. L. Scott of Cornell University has concluded that the increase in total protein requirement for a high rate of egg production is first of all an increased demand for methionine, since the

SUPPLEMENTATION for LAYING HENS

hen must digest over two units of unsupplemented feed protein to obtain enough methionine for one unit of egg protein.[5] He has calculated that the total protein requirement can be considerably reduced by supplemental methionine alone. These calculations assume a diet of adequate energy fed under moderate environmental conditions and fed to a modern, high-producing small White Leghorn strain.

Testing Theoretical Calculations

For example, a flock might require 24 pounds of 16.8 per cent protein feed per 100 hens per day to maintain 72 per cent production. According to Dr. Scott's theoretical calculations, the same flock could produce at the same rate on 19.5 pounds of the same feed with methionine added. Yet each hen would actually be receiving three grams less total protein per day.

An experiment at Babcock Farm, Ithaca, N. Y., tested this hypothesis with an experimental flock of 432 Babcock pullets, randomly distributed on the basis of body weight into eight rows of double cages, about two weeks prior to the onset of egg production. The diets consisted of two practical high-efficiency formulae, with and without the methionine supplementation calculated to be necessary for maximum feed efficiency. Egg size and body weight were checked at the beginning and end of the experiment. Feed consumption and egg production were recorded at 30-day intervals.

Although the test period included the cold months of December and January, one diet supported a five-month daily average of nine pounds of eggs per 100 hens, on an average feed consumption of 20.0 pounds of feed daily per 100 hens. This was equivalent to 2.25 pounds of feed per pound of eggs, or 3.5 pounds of feed per dozen. In both diets, methionine hydroxy analogue increased production and improved feed conversion about 10 per cent.

Improved Feed Utilization

There was a marked improvement in efficiency of feed utilization, especially on the 16 per cent protein diet, and an improvement in egg production on the lower protein diet. Even with the 18 per cent protein diet, additional methionine improved feed efficiency measurably (see Table 2).

When rate of production is used as a factor in calculating nutrient requirements, it must be remembered that an important segment of the flock will always produce at a higher rate than the average. The nutrient requirements of the highest producers must, therefore, be considered in calculating the most economical and efficient dietary formula for the flock.

TABLE 2. Effect of Methionine Hydroxy Analogue upon Efficiency of Egg Production (Cumulative Results for First Five Months of Full Production).

Treatment	*% Production*	*Feed per Doz. Eggs lb.*
Basal No. 1 (16% protein)	64.2	3.95
	65.8	4.31
Average	65.0	4.13
Basal No. 1 + 0.125% Methionine hydroxy analogue*	70.9	3.66
	69.7	3.65
Average	70.3	3.65
Basal No. 2 (18% protein)	67.6	3.80
	68.3	3.77
Average	68.0	3.79
Basal No. 2 + 0.1% Methionine hydroxy analogue*	69.3	3.42
	69.6	3.63
Average	69.5	3.53

*"*Hydan" feed supplement.*

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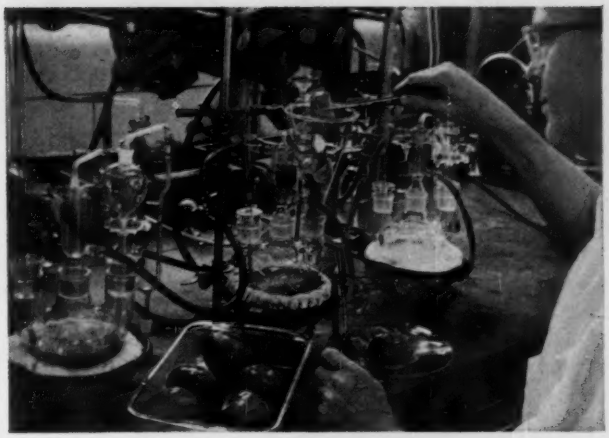
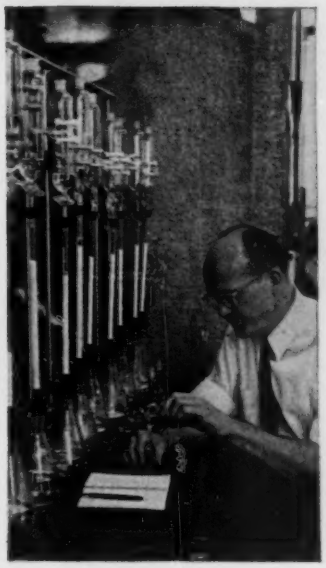
Food for the

New Four Billion

Du Pont chemicals, meticulously tested in laboratory and field, help assure safe, abundant food supplies for our exploding population





HOW much pesticide residue, if any, stays on food or in soil? Important question is answered by precise analytical methods. Tomatoes are checked for trace of fungicide (above). Colorimetric analysis, so sensitive that it can detect one part of a chemical per 100 million, shows whether weed killer is building up in the soil (right).

By Emily Heine
Associate Editor, Du Pont Magazine

An ample harvest of vine-ripened tomatoes is a sight that should please most people, whether they grow the succulent fruits in farm or garden or simply like to eat what others produce.

To men in the Du Pont Industrial and Biochemicals Dept., however, it's a special satisfaction. Ten years ago, a grower considered a yield of ten tons of tomatoes per acre excellent; today he counts on 20 tons and isn't surprised if he gets 25.

Improved plant strains, better fertilizers and greater mechanization are factors in this remarkable increase. But a significant share of the credit goes to a Du Pont chemical, "Manzate" maneb fungicide, first used commercially on tomatoes in 1951; the material now is all but standard. It's notable for its effectiveness against a variety of diseases, particularly the notorious late blight.

This harvest of tomatoes, moreover, is linked to man's age-old struggle to feed himself adequately. For late blight, so successfully stopped today, is the disease that caused the famous Potato Famine of the 1840's, during which ten per cent of the Irish starved and an equal number fled for their lives.

Agricultural chemicals not only are disaster control measures but a form of crop insurance as well. Although the last decade has been filled with talk of farm surpluses, agriculture actually is much more nearly in balance than some other industries. Without chemicals to safeguard production, we would have to have far larger granaries to store for the year of crop failure, as Joseph did.

Boost Production, Trim Costs

Today agricultural chemists also are looking hard for ways to lower production costs and thus to get farmers out of the price-cost squeeze, common enough elsewhere but especially painful in this industry. Ways of increasing production must be sought, authorities point out, because we shortly will face a food problem so huge that, ironically, its very scope makes it all but incomprehensible.

Tomorrow's story is outlined in population statistics: By 1980, experts predict that there will be 275 million Americans, nearly 100 million more than there are now. By 2000, there will be twice as many as there are today. Estimates for the world are even more alarming—nearly seven billion by the year 2000, compared with fewer than three billion today.

In other words, we have less than 40 years to find ways of filling four billion more dinner plates. U. S. farmers will have far less land by then. Our inland cities have grown up in the heart of prime agricultural areas; expansions of suburbs, industries, airports and highways currently gobble up a million acres of good land a year. Improved farm management, soil conservation and increased mechanization will help boost efficiency. But certainly one of the most important factors is chemistry.

QUACK grass killer doesn't pass its greenhouse test unless it destroys root systems to prevent regrowth.

SELECTIVE weed killer succeeded in field by stopping annual weeds without damaging corn.

DIFFERENCE experimental herbicide makes in soybean field is marked by Du Pont's Florian Otto.

At Du Pont, the search for new farm chemicals begins with the testing of new compounds for possible biological activity. "We test them as protectants for seeds, as insecticides, foliar fungicides, soil fungicides, nematocides, herbicides, and plant growth regulants," explains Dr. Rayner Johnson, manager of agricultural chemicals research.

The agricultural scientist focuses on small worlds in order to solve the problems of the population specialist's large one. A step at a time, he learns that a new chemical is effective against one fungus on one plant species at one rate of application in one type of soil under one set of climatic conditions. Hundreds of field tests will be involved before the compound is registered with the U. S. Dept. of Agriculture for full-scale use against tomato diseases. If it is suspected that the material will work on potatoes, too, the same steps must be retraced.

The researcher looks at a map and sees a patchwork quilt: A weed killer registered for use on pineapples in Hawaii, sugar cane in Puerto Rico, cotton in the South, citrus in California, asparagus in New Jersey.

Without the satisfactory completion of work by scientists in two even smaller worlds, however, some of the patches would be missing. Finding a promising pesticide is easy enough: Hundreds of thousands of chemicals that may show biological effects are as yet untested.

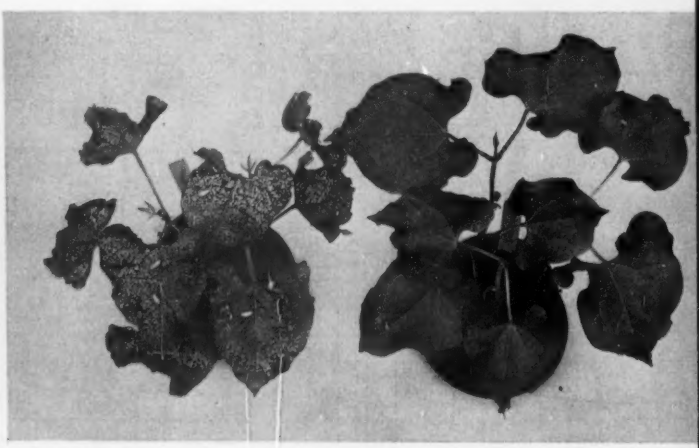
"The greatest single item in developing an agricultural chemical today is the work required to prove its safety in all respects," says Johnson. Chemicals that look promising in greenhouse tests go at once to the Company's Haskell Laboratory for Toxicology and Industrial Medicine. Scientists there test them on laboratory animals and send back preliminary information on approximate lethal dose (ALD). A good many materials are dropped straightway as too dangerous for the average person to handle.

Haskell follows with "ten-day subacute" tests, which give an idea of the cumulative effect of the compound, and a check for skin irritation. If it survives these, it's cleared for testing in the field.

Test Plots by the Thousand

In 1960, Industrial and Biochemicals Dept. research men put out more than 6,700 test plots in

LATE blight withers untreated tomato plant while chemical keeps another healthy. This is how Du Pont scientists evaluate new material as fungicide.



MEXICAN bean beetles devour unsprayed bean plant but don't harm one treated with a new chemical under evaluation as a possible insecticide.

13 states. They studied fungicides on apples, celery, cherries, cucumbers, grapes, peaches, peppers, potatoes, strawberries and tomatoes; herbicides in corn, cotton and soybeans; insecticides on cotton, tobacco and a variety of vegetables. Such work is painstaking, frequently tedious. A single foliar fungicide test, for instance, may involve 80 plots and 2,000 operations—soil preparation and fertilization, planting, cultivating, 12 applications of chemicals in small doses, disease evaluations and yield counts. Produce from such plots is carefully destroyed, since safety to the consumer is not yet assured.

If plot work looks promising, Haskell Lab begins 90-day feeding tests on laboratory animals. If the chemical is to be used on food crops, Haskell also starts two-year studies on rats and dogs. Possible effects of the chemical on the animal must be traced meticulously through micropathological analyses of the blood and vital organs. In special reproductive tests, rats are followed through three generations. More than 3,300 animals may be involved.

Meanwhile, the analytical chemists have been hard at work in another small world. Before the compound could be made in field test quantities, they had to characterize its structure precisely and determine its purity. Their most exacting task, however, is finding a way to measure how much residue, if any, remains on the food crop at harvest.

Tracing the Residue

Under the 1954 pesticides amendment to the Federal Food, Drug and Cosmetics Act, the Food and Drug Administration sets the safe level of residue that can be permitted in a food crop. This is a tiny fraction—often one-hundredth—of the amount that has been found to have no effect on laboratory animals. Good agricultural practice, however, may cause even less of the chemical to remain; if so, the lower level usually becomes the legal tolerance.

The traces the Du Pont men look for, then, often are as small as one part per ten million—roughly an ounce of pesticide evenly distributed in 310 tons of produce.

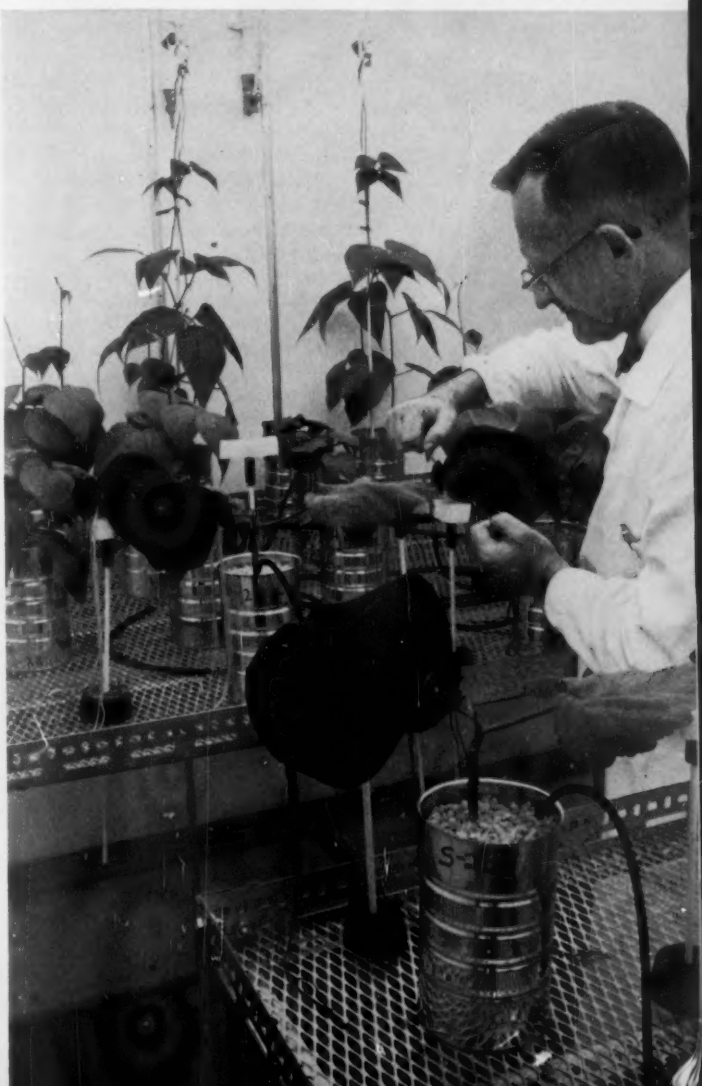
"If you had to look for a needle in a haystack," says Johnson, "you might find it by setting fire to the hay and going over the ashes with a magnet. Often times we follow a similar principle in making a residue analysis. For example, we find a reagent that the chemical we are interested in can withstand, and then use this reagent to digest the plant tissue, leaving only the minute residue of the chemical. From this point on we may use a physical technique, such as infrared spectrophotometry. Or we may search for a chemical reaction of the residue that will yield a characteristic color. With such methods we can sometimes detect one part of the chemical in **100 million** parts of plant tissue. Another interesting technique that we sometimes use is gas chromatography.

"The safety question has still more angles," Johnson continues. "We need to establish a safety factor as far as the crops themselves are concerned. For instance, how much more of a new compound than is needed to control fungi can be put on without damaging a plant? In case of an isolated, accidental over-application, can the plant safely withstand two to four times the recommended dose?"

In spite of progress in use of pesticides, farmers still endure an estimated loss of over seven per cent of crop productivity from plant diseases, the Dept. of Agriculture figures. Weeds cost at least 10 to 15 per cent of the productivity of all crop and grazing land. Many people have never heard of nematodes, yet these tiny root parasites annually take a $300 million bite out of farmers' incomes.

There still is abundant room for improved chemical protection against almost every sort of plant pest. But the dominant need is for basic information about plant systems. Pitifully little is known, for instance, about fundamental growth

COCKLEBURS flower after nine hours of steady darkness under black caps. Dr. Norman Searle studies the biochemical basis for this response to learn how chemicals can control flowering of crop plants.



processes and how a large number of variables affect them.

Men in both the Industrial and Biochemicals and the Central Research departments are working to throw light on this age-old question. They have as a practical goal chemicals that can make plants more resistant to frost or to drought, more fruitful in terms of the number of flowers, fruits and seeds. They are looking, too, for ways to stimulate root growth or speed up ripening once full growth has been achieved. In the past, such properties have had to come through plant breeding. But if chemical catalysts or inhibitors can be found, the farmer will have far more precise control over the vagaries of weather and climate.

Weeds in Splendor

Beans, millet, sumac, cockleburs and other plants live in unnatural splendor in the Central Research Dept.'s plant growth laboratories. "Quarantined area. Do not enter unless authorized," reads a sign outside. Not only are the plants thus protected from unplanned introduction of insects and diseases. Light, temperature, humidity and nutrients are strictly controlled in an effort to learn exactly what makes plants grow.

Leave these laboratories, and enter the greenhouse across the street. Here there's no quarantine. "We're interested in helping plants battle their natural enemies," the guide explains, "so we take no unusual precautions to protect them."

At one side of the front room, tomato plants whirl on a turntable, as a chemical is sprayed on them. Across the way, plants are inoculated with late blight and then aged in a humidity chamber for 24 hours. Unsprayed control plants soon wither; the protected plants flourish. "Compound 920 shows considerable promise as a fungicide," a Du Pont scientist writes in his notebook. The long journey from laboratory to commercial grower is about to begin.

ENVIRONMENTAL conditions are precisely controlled through elaborate control system. Temperature, light, and other factors are accurately maintained for studies of the effect of new biologic chemicals on plant metabolism.

new recommendations for DU PONT BIOCHEMICALS

After each growing season, manufacturers of agricultural chemicals receive reports of research and commercial trials which are the basis for changes and additions to product recommendations. These data are reviewed by technical people, checked for economic value to the grower, and carefully examined in terms of the residue and toxicity factors affecting the proposals.

If the evidence indicates that the label should be changed, the proposal is submitted to the U. S. Department of Agriculture, the Food and Drug Administration, and to state authorities, for required approval of the new commercial label recommendations. Since it is difficult to accomplish all this between the end of one growing season and the beginning of the next, the Du Pont Company provides "supplemental label information" in bulletins made available through agricultural chemicals dealers, Du Pont representatives, or from the Editor, *Agricultural News Letter*, Du Pont Company, Wilmington 98, Delaware.

Following is a summary of supplemental label recommendations which have been added to Du Pont products for the 1961 season.

Apple and Pear Orchards — Weed Control: Seedling annual weeds under apple and pear trees can be controlled chemically with "Karmex" diuron weed killer at less cost than cultivation and hoeing. Elimination of weeds is desirable to conserve soil moisture and nutrients and to remove cover for rodents and insects which damage trees. Well-established annual or perennial weeds should be removed before treatment by cultivation or other means.

Analytical studies show no chemical residue in or on apples or pears properly treated. For trees, the material has shown a good degree of safety in established plantings under most conditions. It is not, however, recommended for use around dwarf or semi-dwarf varieties, transplanted young trees within the first year, or on light sandy or gravelly orchard soils.

"Karmex" should be applied under the trees or as a band application in the tree row, at no more than four pounds per sprayed acre, in at least 40 gallons of water. Application should be made before new annual weeds start to germinate and grow — March to May in most areas. Where fall treatment is desirable, the four pounds can be split into two applications, of two pounds each,

one in the spring and the other after harvest.

Established Blueberries — Weed Control: For control of seedling annual weeds and grasses in established plantings of blueberries in Michigan and Ohio, "Karmex" is recommended at two pounds per sprayed acre, applied before growth and germination of annual weeds, and at least 60 days before the first picking.

Cotton — Weed Control: Under new registration changes, lay-by treatment with "Karmex" is recommended immediately after the last cultivation, but not before the cotton has reached a height of at least 15 inches. With "Telvar" monuron weed killer, which is recommended in certain areas of the Southwest only, cotton may be treated at a 20-inch minimum height.

The new labels for these products also state cotton, corn, and grain sorghum (*not* sorgos, forage sorghums, or grass sorghums) may be planted in the spring of the year following treatment, but no other crop should be planted within one year.

Asparagus — Weed Control: The new supplemental label for "Telvar" recommends as follows regarding time for application:

Make first application before weeds become established, but no earlier than four weeks before spear emergence and no later than early cutting period. *However, where weeds are controlled into the cutting period by cultural practices, application may be delayed until immediately after the last cultivation.*

Grazing Land — Brush Control: A quick, easy method of controlling brush in pastures and rangeland is now available to farmers and ranchers east of the Rockies, and is recommended in Arizona and New Mexico for control of alligator juniper *(Juniperus deppeana)*. This registration for the pelleted "Dybar" fenuron weed and brush killer has been accepted by Federal authorities. "Dybar" has been used commercially as a brush killer since 1958, but use in most areas has been restricted to non-cropland locations, such as rights-of-way and fence rows.

Lima Beans — Disease Control: "Manzate" maneb fungicide, previously recommended only for downy mildew, may now be used on lima beans for control of anthracnose (*Collectotrichum truncatum*) which affects both foliage and pods. It can be applied in spray or dust mixtures, at weekly intervals, up to four days before picking.

Peanuts — Disease Control: "Manzate" maneb fungicide is recommended for use on peanuts for control of *Cercospora* leafspot, in spray or dust mixtures, at 10 to 14-day intervals or weekly during rainy humid weather favoring disease development. Treated peanut hay should not be fed to livestock.

Cotton—Seedling Diseases: Du Pont "Manzate" maneb fungicide, as a 20 per cent maneb dust, is recommended as a planter box treatment for cotton in the Mid-South. A similar recommendation is being developed experimentally for "Thylate" thiram fungicide. Treatment generally improves stands by reducing losses from seedling diseases caused by soil organisms such as the *Rhizoctonia, Fusarium,* and *Pythium* species. The dust is used at the rate of three pounds per bushel of seed, and the planter should be calibrated to determine the seeding rate for the mixture of seed and fungicide. For best results, the seed should be properly treated with one of the Du Pont "Ceresan" seed disinfectants.

Total loss from seedling diseases is estimated to cost cotton producers $10 million per year in Mississippi alone. Planter box treatment has been under test in Mississippi for several years, and has proved effective.

Tomatoes—Disease Control: "Fermate" ferbam fungicide is now recommended for control of gray mold and sclerotiniose of tomatoes in Florida.

Celery — Disease Control: "Thylate" thiram fungicide is now recommended for control of early blight (*Cercospora*), late blight (*Septoria*) and *Rhizoctonia* in Florida celery fields. The recommendation is 1½ pounds per 100 gallons of water, with applications at three- to seven-day intervals, depending on conditions. Treatment should be stopped seven days before harvest, and residues removed by stripping, trimming, and washing.

Sweet Corn — Corn Borer: More effective control of European corn borer on sweet corn is now possible with increased rates of EPN (ethyl p-nitrophenyl thionobenzenephosphonate) insecticide. The new dosage recommendations are approximately double the previous rate: Granules, 20 to 50 pounds per acre; emulsifiable, one-half to one pint; wettable powder, one to two pounds.

The wettable powder is Du Pont EPN 300 insecticide. Granules (one per cent active) and a liquid concentrate (four pounds per gallon) are available from insecticide formulators. Commercial dust mixtures based on EPN are also available. As with all highly toxic chemicals, directions should be carefully followed.

Pecans — Insect Control: EPN 300 (wettable powder) is recommended in commercial pecan groves (not home plantings) for control of various insects, including pecan nut case-bearer, hickory shuckworm, pecan weevil, pecan mite, aphids, southern green stink bug, fall webworm, walnut caterpillar, twig girdler, and May beetles. Each insect requires a specific schedule of applications, and details are given in new supplemental labeling. EPN may not be applied later than 21 days before harvest, nor may livestock be grazed in treated groves.

three years' experience proves

COST SAVING WITH PLASTIC

More than three years' experience with the first large-scale commercial greenhouse to use weatherable "Mylar" polyester film for glazing shows that initial investment can be reduced to one-fifth of a comparable glass structure. A further substantial saving results from a two-thirds reduction in maintenance cost.

Rivermont Orchids of Signal Mountain, Tenn., decided upon "Mylar" during an expansion in 1958. The price for glass structures was $3.50 per square foot of ground cover, plus 10 cents per year for maintenance. As pointed out by Odie M. Helton, former general manager, "We realized that our greatest savings in costs could be in the structure's framework. Because of the greater width and lighter weight of plastic, we would be able to reduce the number of structural members due to the longer span between rafters. We decided that since the structure would account for over 80 per cent of the total outlay, we would apply the best plastic glazing film we could find. Everything pointed to the fact that, in the long run, 'Mylar' polyester film was the lowest cost glazing plastic we could find. We still believe this to be true."

Using Unskilled Workers

The structure measured 28 by 102 feet and used wooden roof framing and galvanized pipe for braces and supports. Wood was treated with preservative and painted; all metal, except galvanized pipe was covered with rust inhibitor. Glazing was done with five-mil weatherable "Mylar" Type W. The firm's own workers, although unskilled in carpentry and glazing, were used, and the structure completed for $1.39 per square foot, including benches and heating and ventilating equipment. The cost breakdown was as follows:

Wood members	$ 480.00
468 feet galvanized 1¼ inch pipe	145.08
372 feet galvanized 1½ inch pipe	133.92
Benches (wood, cement, block)	300.00
Electrical wiring	37.50
Pipe fittings	31.00
5,200 square feet five-mil "Mylar"	700.00
3,500 square feet one-mil "Mylar" (lining)	50.00
Tape for sealing inside joints	40.00
Two 65,000 BTU gas heaters	276.00
552 feet six-inch galvanized air conditioning pipe	138.00
Two 42-inch fans with automatic louvers	211.90
One ventilating louver	14.70
Nails, miscellaneous hardware	21.75
Automatic watering system, pipe and nozzles	61.08
1,080 man-hours at $1.25 per hour	1,350.00
Total	$3,990.93

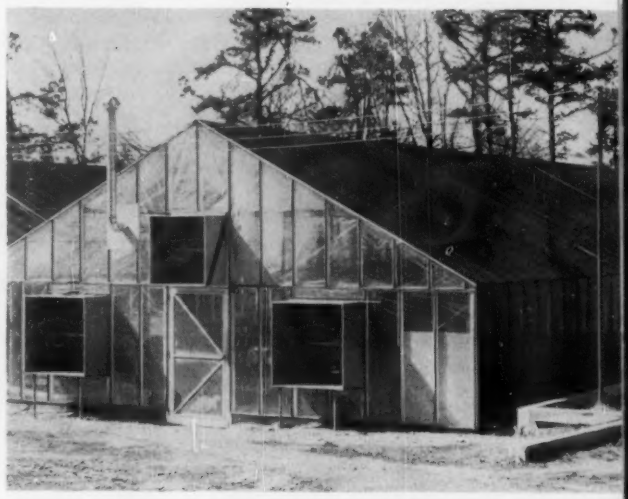
A comparable glass house would have cost as much as $12,000, according to Helton. Experience showed that a cost reduction to 75 cents per square foot could be achieved with "Mylar". The first house was "overbuilt," says Helton. In later structures "we eliminated all pipe braces and supports by using prefabricated trusses and structural supports of wood. The sections were preassembled on the ground, then raised into place and tied in all at one time. We also found that there was no need to tape the three-inch film overlaps; stretching the 'Mylar' polyester film drum-tight lengthwise along the roof, plus the natural bond established at overlaps by moisture, was sufficient to maintain a seal even under high wind loads."

Savings on Heating

Another saving was realized by using lower-cost two-mil polyethylene for the inner liner film since the destructive ultra-violet light is already filtered out by the outside layer of "Mylar". The purpose of the inner layer is to create an insulating airspace of two inches which saves about 30 per cent on heating. Helton also estimates that there is a substantial heating and ventilating cost reduction because the "plastic house is a tighter one" than a building using glass.

Maintenance was virtually eliminated. Assum-

THREE YEARS without maintenance of glazing, greenhouse using weatherable "Mylar" polyester film is still in perfect shape. Third ventilating fan and chimney for place heater were added to structure.



GREENHOUSES

ing a five-year life, reports Helton, "we figure we can completely reglaze at the end of that time for 16.5 cents per square foot of glazing area," 13.5 cents for film and three cents for labor and incidental materials. This is an amortized annual reglazing cost of slightly over 3.3 cents per foot, or roughly one-third of what it now costs to keep glass houses in good shape. It is possible "Mylar" will last longer since there is no evidence yet that any part of the glazing is breaking down.

More Light on Plants

The firm also believes that there is more light on plants in plastic houses. First, because of the lighter weight roof, "we don't need as heavy or as high a foundation at the sides, thus the plastic glazing goes all the way to the ground, while the glass house sides are transparent only for about half that distance. Second, because of the reduction in the number of shadow-casting members in the roof the (three or four foot spans, versus some 20 inches for glass) average light available during the day should be greater."

Commenting on the importance of the development project at Rivermont, President Neil McDade said, "Ever since my father, Clint McDade, started this business in 1939 as the outgrowth of a hobby, we have used research as one of our basic tools. Our continuing development work in hybridizing and plant culture, from seed to flowering plant, plus innovations in packaging, has built a clientele, both amateur and professional, in 40 countries in the world.

HIGH LIGHT transmission of weatherable "Mylar" polyester film requires shade control over blossoming orchids. The vapor-lock overlap of the film (arrow) is the only indication of a barrier between camera and subject.

"You can bet your bottom dollar that we wouldn't have a large part of our 40,000 producing plants and 100,000 seedlings under 'Mylar' polyester film unless we were confident that this new film was safe to use.

"Should conditions warrant an expansion of this range in the future, we wouldn't hesitate to glaze with 'Mylar' — its demonstrated economies all across the board to date have proven it the best and most economical material for the job," he said.

ADVANCED "ridge and furrow" design of four structures at Rivermont Orchids, Signal Mountain, Tenn., uses wood throughout. Cost is approximately 75 cents per square foot with "Mylar", roughly one-fifth cost of using glass. Houses were erected with firm's unskilled workers.

new PRODUCTS AND APPLICATIONS

A new type of refrigerator car door gasket of neoprene synthetic rubber gives greater protection to perishables and eliminates added costs. It withstands weathering and such corrosive materials as condensed moisture, brine, and acids in refrigerator cars. Neoprene has given service in outdoor applications for as long as 30 years and the gasket is expected to last the life of the refrigerator car. One advantage of the gasket is lower installation time compared with materials which require painstaking fitting because they were easily deformed under stress or pressure. The one-piece neoprene gaskets require only an adhesive for installation and staples at each corner until the adhesive dries. Reduced initial installation cost and elimination of replacements during the life of the railroad car result in economies for the user.

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The unique properties of polyethylene in bond with cellophane are now answering the requirements of a hard-to-package farm supply item: Nitrogen fixing bacteria. The film combination gives the bags greater strength, more control of moisture protection, and better package appearance than either polyethylene or cellophane. In addition, pigment in the polyethylene resin protects the bacteria from damaging rays of heat and sunlight. The white-coated surface also provides a solid background for the attractive green and yellow design reverse printed on the cellophane. Use of the new bag also permits use of completely automatic packaging and reduces costs by 25 per cent. Production has been increased and shipping costs have been reduced through use of the new package.

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Water hammer, the loud thumping noise caused in plumbing by the rapid closure of a valve, may often be eliminated with a new shock absorber of "Delrin" acetal resin. The cylindrically shaped unit with displacement capacity of four cubic inches consists of an outer shell of "Delrin" and inner tube of specially compounded rubber. High pressure peaks occurring after valve closure are absorbed by the inner tube. The device can be installed on lines leading to laundry units, kitchen sinks, or dishwashers. Diagrams are provided by the manufacturer to indicate proper installation. "Delrin" will not corrode, is resistant to repeated shock pressure, and is impervious to damage from most chemicals and from 180° hot water.

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Ropes of nylon or "Dacron" polyester fiber manufactured by Synthetic Ropes, Inc., carry a unique two-year performance guarantee. Rope will be replaced without charge if it fails within two years due to defective construction or fiber quality. Extensive tests show ropes of nylon are more than twice as strong as manila of the same size, while those of "Dacron" have 1.5 times the strength of manila. Synthetic ropes have the advantage of greater resistance to moisture, salt water, mildrew, chemicals, acids, petroleum products, and abrasion. Synthetic ropes are used widely in boating and have many uses on the farm, especially where unfavorable conditions are encountered.

A full guarantee for 20 years of trouble-free service is now offered by the manufacturer of "Heirloom" garden hose made with Du Pont "Hypalon" synthetic rubber. Being a vulcanized elastomer "Hypalon" will not soften in hot weather or become brittle when it is cold. It resists abrasion, sunlight, weathering, farm chemicals, acids, and other products which may have a damaging effect on rubber. Even smog laden with ozone, the deadliest enemy of natural rubber, will not damage "Hypalon". In addition, it has outstanding ability to resist damage from bending or kinking, and its bright green color will not fade during the life of the hose.

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A new Du Pont wall paint is especially suitable for application by the farm handyman or members of the family, because it eliminates almost all of the fuss and mess associated with interior painting. "Lucite" wall paint is an acrylic-type emulsion of a creamy consistency. Because of its heavy body, it does not drip, run, or spatter like ordinary paint. Yet, it is thixotropic and will, therefore, flow into a smooth, even coating when applied by brush or roller. Nor is the usual fuss of stirring required, since the paint is ready for application as soon as the can is opened. Another advantage is that brushes and other working tools can be cleaned up with water.

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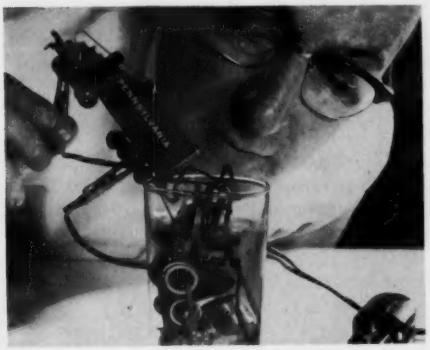

A selective cleaning agent that will remove grease from small, hard-to-clean parts on farms or in homes is available for the first time in small quantities for home use. Since the solvent does not affect plastics, metals, insulation, paint, or varnish, it is suitable for use in cleaning such things as paintings, photographic films, and book covers. And, it makes a good watermark detector for stamp collectors. Hobbyists may use the product to clean miniature engines or parts. Since the solvent is non-conductive, cleaning may be carried on while equipment is in operation. Du Pont manufactures two "Freon" industrial solvents which are blended by another manufacturer to make "En-Irt" cleaning fluid.

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A flush-toilet tank ball and guide that stop leakage and annoying drips can be installed without tools, nuts, or bolts. Easily fitted to overflow pipes of various diameters, the unit is made of non-corrosive "Alathon" polyethylene resin. It promises long life and an end to "handle jiggling." The polyethylene ball retainer automatically centers over the flush valve, seating the rubber ball on the valve in perfect alignment. Installation can be made in a few minutes. First, the conventional wire guide and tank ball are removed. The plastic is slipped around the overflow pipe. The chain is connected to the trip lever to complete installation. Du Pont manufactures "Alathon" resin from which the unit is made.

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Washing machines have been developed and put into operation to de-fuzz and clean wet or dry peaches. Key to the operation are brushes made with Du Pont "Tynex" nylon monofilament. The new equipment eliminates the old dry-brush method that left much to be desired. Since the equipment uses cold water spray for processing, peaches from rain-soaked orchards need not be dried. Also eliminated are blowers required by the dry method. The machines clean away harvest debris along with the fuzz, and the water carries away pulp from broken overripe fruit before it can mat brushes. Substantial cost cuts result from savings on ice, labor, power, and protective tarpaulins.

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Ten new products for pleasure-boat owners have been added to Du Pont's "7" SEAS line of boat and engine care products. These are boat bottom cleaner, engine cleaner, heavy duty fiberglass cleaner, scratch remover, boat polish, boat wax, plastic windshield cleaner, and three cellulose sponge products designed for specific marine cleaning jobs—a reinforced sponge cloth, the "Captain's Combo" synthetic sponge, and the Giant Deckhand sponge. The "7" SEAS line, launched in the spring of 1960, is now the most complete family of marine specialties available from any manufacturer. New products to meet particular needs will be added as they are developed in Du Pont's laboratories.

METHOXYCHLOR AIDS IN CONTROL OF DUTCH ELM DISEASE

Dutch elm disease can be effectively controlled through the use of a sanitation program plus the insecticide, methoxychlor, on a practical basis without causing significant losses in wildlife.

Sanitation is the most direct control measure, as cutting and burning dead and decaying elm wood destroys fungus and beetles. This practice, combined with thorough mist-blower applications of three to four gallons of methoxychlor in a 12 per cent spray per mature elm during the dormant season, will reduce annual diseased elm losses to less than 1 per cent of the involved trees.

The average price of effective tree protection for 40 to 50 years will not exceed the average cost of removing trees that succumb to the disease. Actually this spreads the tax bill of a city out over several years.

Studies in Wisconsin during the last three years have emphasized the development of an alternate insecticide to DDT for Dutch elm control because of the concern which existed over the substantial losses in wildlife.

Research with the insecticide, methoxychlor, had indicated its considerable toxicity to elm-bark beetle and very low toxicity to wildlife. In comparative tests with DDT, methoxychlor gave control of beetle feeding ranging from 93.7 per cent to 96.4 per cent, while DDT gave 95.1 per cent to 99.3 per cent. These studies involved effectiveness tests through 102 days after applying four gallons of 12 per cent spray insecticide per 90- to 100-foot elm.

In tests conducted by the University of Wisconsin and reported at the Western Wild Life Conference in December, 1959, methoxychlor proved to be only 1/10 to 1/12 as toxic as DDT to robins.

NEW GENERIC FOR "ARASAN"

Du Pont's product, "Arasan" 42-S, which originally started out as a seed disinfectant, has proved so effective as a repellent (see *Agricultural News Letter*, Fall, 1960) that the generic has now been changed from thiram seed disinfectant and protectant to thiram fungicide and repellent. Seed disinfectant recommendations will no longer appear on the printed label, but will be available as a separate bulletin (from Editor, *Agricultural News Letter*, Du Pont Company, Wilmington 98, Del.) for those who want to use the product on seed. Animal repellent recommendations are being added to the label as it is printed with the new generic.

RECORD PARTICIPATION IN 4-H BEEF PROGRAM

The 1960 national 4-H beef awards program, sponsored by the Du Pont Company, scored one of the largest increases in county participation ever recorded. Medal awards were made in 2,401 counties, an advance of 594 over the previous year. An increase of 1,872 individual medal winners over 1959 brought the total number of recipients to 7,571. Total enrollment in the beef awards program set a new high of 139,691 boys and girls, according to the National 4-H Service Committee.

Forty-four states and Puerto Rico qualified for the beef awards program out of 48 states accepting. Iowa led in program enrollment with 13,566 members. Oklahoma, Texas, Illinois, Georgia, Mississippi, Nebraska, and Tennessee all had an enrollment of 5,000 or more. Illinois reported more than 8,000 carried beef projects in 1960, boosting beef ahead of all other 4-H agricultural projects in that state for the fourth year in a row.

The 1961 beef awards program is now underway. This year, medals will probably go to more than 8,000 youngsters in counties throughout the country. State and national winners will be selected from these. They will be honored at the 1961 4-H Club Congress in Chicago this fall.

FDA CLEARS CELLOPHANE FOR USE WITH FOOD

Cellophane, as described in a Food and Drug Administration regulation recently published in the *Federal Register*, has been confirmed as safe for packaging all types of food. "This formal recognition of safety for cellophane," stated Robert R. Smith, of Du Pont's Film Department, "brings to a happy conclusion the intensive cooperation between our research, development, technical, toxicological, and legal personnel and officials of the Food and Drug Administration. The data developed by this task force now confirm that cellophane, as described, meets all requirements set by the Food Additives Amendment of 1958."

The government action is one of the first major regulations by the Food and Drug Administration concerning a packaging material. The Food and Drug Administration has also concurred with Du Pont in the conclusion that the colors as used by Du Pont in its new "K" cellophane 210-FC varieties are non-migratory and are not, therefore, food additives within the meaning of the Act. As a result of these rulings all types of cellophane now manufactured and sold by the Du Pont Company for use in contact with food have been confirmed as safe.

Farmers Ask About....

Q: How fast could flies multiply?
A: **One pair, if all offspring survived, could produce 191 quintillion in one season. These would weigh 9.5 trillion tons and occupy 110.5 quadrillion cubic feet.**

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Q: What important centennials for agriculture will be observed in 1962?
A: **Establishment of the U. S. Department of Agriculture and of the land-grant college system.**

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Q: How much effort does industry make to control pollution?
A: **The Du Pont Company has spent or authorized $63 million for pollution control.**

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Q: How do rose authorities determine the effectiveness of fungicides?
A: **The Texas Rose Research Foundation considers weight of bushes at digging time a fair measure of quality and size and, therefore, of the accumulated benefit of fungicides. By holding leaves, rose bushes grow larger and heavier.**

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Q: How efficient are plants as converters of solar energy?
A: **A Wisconsin report says green plants use less than one per cent of the sunlight falling on the earth. Yet, under controlled laboratory conditions, plants may use up to 30 per cent of the light energy they absorb.**

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Q: Is there a paint that doesn't drip?
A: **There is: Du Pont "Lucite" wall paint does not drip or spatter, and brushes can be washed with water.**

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Q: Is it possible to tell how good a steak is while "on the hoof"?
A: **Analysis of the echoes from high frequency sound waves bounced off the layers of fat and muscle on live animals has been developed at Cornell University for this purpose.**

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Q: Why do azaleas need an acid soil?
A: **Research in New York and Oregon shows the fundamental cause of nutritional difficulties in high pH soil is that iron is tied up in the leaf tissue.**

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Q: Has business really turned the corner?
A: **Yes, Du Pont business is up but the Company is still faced by the cost-price squeeze. The earnings rate is expected to be lower than last year.**

Q: Why does washing eggs sometimes increase spoilage?
A: **A U. S. Department of Agriculture study shows wash water containing a high concentration of iron (5 to 10 parts per million) carries the iron through the shell and shell membrane into the inner egg tissue. Iron reverses the protective action of the iron-binding protein in egg white and accelerates spoilage by increasing the amount of iron available for spoilage bacteria.**

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Q: What is a good indicator of the nitrogen fertility status of cotton?
A: **The nitrate-nitrogen content of the petioles (leaf stalks) of cotton plants during the growing season has been found to be consistently related to the rate of nitrogen applied.**

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Q: Is Du Pont stock owned by many colleges?
A: **A survey of the endowment funds of 64 colleges shows Du Pont to be among the 10 most widely held stocks.**

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Q: What does farm work with machines cost versus doing the job by hand?
A: **In most operations, a man would have to work for 15 cents an hour or less to be competitive with machines.**

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Q: Do pest control costs vary with weather?
A: **Great seasonal variations are common in costs of controlling insects and diseases on field crops. Cost in fruit crops is relatively uniform, because sprays are applied for protection, according to pre-determined schedules.**

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Q: How do corporate dividends compare with tax payments?
A: **For Du Pont, taxes are usually higher. Dividends per share of stock were lower seven out of the last 10 years than taxes.**

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Q: Does the face fly enter homes?
A: **A VPI report says face flies are seeking shelter in upper floors and attics of houses.**

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Q: What gives meat its characteristic flavor?
A: **USDA reports flavor is in the fat, not the lean meat. Flavor extracts from lean taste the same for various meats.**

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Q: Can milk cows show a negative nitrogen balance even when consuming more than their established protein requirements?
A: **Yes. This can happen with energy-deficient diets which result from lack of grain, failure to consume sufficient silage, or from feeding mature forage low in digestible nutrients.**

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